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"A personal approach"

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Introduction

With this paper I have tried to give an insight in my way of thinking and working.I will talk about aspects of the theoretical as well as the technical side.
The first one,I have left brief,mainly because this is, in me ,an area still to much in state of fluctuation which causes to outdate the written rapidly.In the meantime it's presence is important to give the above mentioned insight the right flavour.

Concerning the technical side,I have chosen one particular area to expatiate on.This seemed to me the most usefull for myself and others.
I have written on the fundamental elements of mouldmaking and,through this,hope to make it easier to understand the mechanics of the process.Only through cultivating this understanding,new technical exploration and innovation will be possible.This technical part is not an easy manual to mouldmaking but a list of components and their function,usefull when working in the field.

Source of inspiration

A General

Over the last year I have endeavoured to work in two areas,being glass sculpure and glass jewellery.These might appear quite different areas but,to me the final pieces are strongly related since both have been inspired,have been born out of the same impulse,being the desire to embody a particular personal experience.

"Experience" to me is one of the most powerful qualities of life and,giving in to a very human tendency,I too felt the urge to communicate that which seems to me powerful and/or important at the time.In the meantime,I know that experience is one of the most difficult things to communicete.It's like looking for radio contact and only those tuned in one the same wavelength will pick up the signal and understand, the others will hear the hissing,bleeping,whistling,etc. and, understandibly,look for an other station.To me the piece I create is the signal I put to air.I endeavour the signal to be clear to me and to recall in me the experience it is supposed to express.

Finishing a piece can be rewarding and can have other motivating factors go with it but sofar it has been the creative process I've thrived on.
In dutch we have a saying "waar het hart van vol is,loopt de mond van over" which means something like"the mouth overflows with what the heart is full of".Relating this to my work I would say "out of the hands flows what the heart is full of" and I suppose this is my mode of communicating experience.
The working process to me consists of three things,an exhaust-valve for bottled up experiences,a digestion, interpretation and usage of external influences and observations, and a fascination with the technical process of creating glass.

To go back to the radio signal I can say that I might not always like the sound of the signal but I've always loved the creating of it.

In the work process I move from a conscious to an unconscious,from a premeditated,deliberate to a spontaneous approach.I enjoy both ways of working for their balancing effect.

At the time of creation,my jewellery represented the more unconscious,spontaneous side and the sculpture the more conscious,deliberate.

B Jewellery

When I started to make the jewellery,especially the neckpieces I made them because it felt right,the look appealed to me and they fitted the body in their own peculiar way.

My ever questioning nature had to find out why I chose this type of jewellery.Through paying attention to and analysing other pieces of jewellery I came to the following observation.

In our culture an obvious and well-known function of jewellery is beautification,an other one is indication of wealth,class and (sub)culture.(I realise that this is only a superficial indication of an interesting area in sociology) With my jewellery I'm not trying to change these things butt add something. I want my jewellery not only beautify and classify women but emphasize a womens strength,power and grace.I want it to underline the side of women,I would describe as strong,stable,warm,heavy but translucent and the presence arising from these qualities.I admire power born of deep inner strength and equlibrium and would like my jewellery to be in tune with this.

The shape of my jewellery,in particular the neckpieces evoke,when worn,a strong body posture. I have,at first unconsciously,chosen their shape,partly for this reason and partly to be a simple,strong carrier for the glass design. A shape that would positively influence the material it's made from but not distract from it.

In the process the outside shape(circle,line,etc) is decided on before making the rough glass form.The refinement of the form is developed in dialogue with the mosaic the piece consists of.Through a process of cutting and grinding I try to pull out the most interesting aspect of the underlaying mosaic and give the final surface texture a nice tangible quality,a quality that evokes the need to touch and to be worn.

Using glass only is an approach which appeales to me. Combining glass with other materialsis another.The latter can be used to solve certain design problems faced with by working in glass only.Initially this motivated me to turn to other materials,but at present an interest in the interaction between glass and other materials rather than a practical reason forms the motivation behind the choice.Sofar I have used the combinations glass/rubber and glass/anodised aluminium for their aesthetic compatability.

I will conclude this paragraph with a brief insight into the fabricationprocess of my pieces.

Mosaic glass jewellery fabrication

-- The base form is carved into a plastermixslab or ceramicfibre board.This forms the fusing mould.
-- A basic descission is made on pattern and type of mosaic and acolour palet is chosen
-- Through stacking and layering the mosaic is formd in the mould.
-- The piece is put through a basic fusing firing.
-- After this firing the piece ,usually,has a ve ry non appealing appearance.To turn it into the final product it now goes through a cutting,grinding and polishing process,whereby I make use of varios machines such as, diamond saw,glass lathe,flatbed grinder andlinisher.

An insight in mould making

Introduction

This year I have focused on the lost wax kiln casting process.An initial idea,developed through drawing,modeling andmaquette making,resulted in a shape only possible to realise through the lost wax casting technique.This in combination with my desire to make "real" 3D forms,as opposed to freestanding 2D or low relief forms,gave me the motivation to tackle this technique.

Through lack of readily available information it was a process of trial and error with as a result the obtention of understanding of mould materials and methods and of the behaviour of glass in the casting process.

This part will deal with an approach to mould making for kilnwork rather than a detailed talk about the particular technique and mould I have used under my specific circumstances. I am of the opinion that each project,each piece,each set of circumstances has it's own specific requirements and it depends on these which mould one will use.The usages of moulds can put forward puzzeling problems.The making of them can be very elaborate and since the ration of time is always to small one should search for the quickest and easiest way. Hence an insight seemed usefull.

The following is written with the assumption that the reader has a basic understanding of kiln techniques as well as sculptural moulding processes.If not I'd like to refer to existing literature on these topics and the bibliography of this paper.

At first I'd like to give a definition of "mould" according to the Macquarie Dictionary.

Mould - a hollow form or matrix for giving a particular shape to something in a molten or plastic state.
- that on or about which something is formed or made.

I have approached the area of mould making from three directions:glass,material and method.

We have to deal with glass,which through heating moves from rigid to molten and back to rigid.In this process we have to deal with tention,gravity,viscosity,defitrification, adhesionof molten glass to many materials,enealing,thermal shock etc..Than we have matter with which we want to control the glass in the molten state.This matter has to be suited to it's specific task of which important factors are the handling of extended exposureto temperatures up to 960°C and suitability for the glass working process.Finally there are various methods of moulding this matter.

Glass aspects

I can list a number of factors which I have to take in account whenn making a mould.

Temperature - Glass starts moving at ± 600°C,depending on the type of glass used,and one might have to go as high as 960°-1000°C.The mould used has to be able to stand up to these temperatures.

Defitrification - Does it matter wether the glass defitrifies when heating up? And the same question for cooling down.If not,moulds of insulating material or slow heat transmitting (thick) moulds can be used.If it does,a thin mould might be needed.

Adhesion of molten glass - The surface of the mould should be of a material that doesn't stick to the glass.The choice of this material depends on the final glass surface required and the type of mould.

Viscosity - When one needs a high viscosity,for exemple to fill long narrow areas when casting,it is advisable to use a runny,low melting glass (s.a. leadglass,Desag glass) and a thin mould

to prevent a to large a discrepanty between the temperature inside and outside the mould. When this is not the case one can use a much heavier mould and aesier methods might be applicable.

Enealing - Especially in casting,the thinner the mould ,the more even the cooling of the piece and the quicker the glass temperature equals the kiln temperature. An uneaven cooling of the glass can result in stress and cracking.Uneaven,bulcky moulds can cause this problem.When slumping bulkyness is less of a problem since the glass is directly exposed to the kiln temperature.

Materials

I Types of moulds

I have devided this area as follows : readymade moulds, and made moulds,wether permanent,semi-permanent or one off.

Ready-made moulds

Any material that can stand up to the temperature used for a particular firing and lends it self to be coated,if nescessary,with a releasant can be used as ready made mould, such as terracotta and metals.As releasant one can use materials such as silica,talc,alluminum hydrate, ceramic fibre paper etc.

Permanent moulds

These are made of durable materials such as stainless steal or ceramics and consist of one or a numberof pieces put together,nescessary when the piece has undercuts.They can be costly to make or have made but their long livedness can make it worth it.Personally,I have little experience with making or aquiring these moulds.

Semi permanent moulds

With this term I mean moulds that can last up to 10 or 20 firings.These moulds are similar to the permanent moulds but are made of less durable materials s.a.plaster or concrete mix s,ceramic moulding fibre,ceramic board. After a number of firings,depending on the materials used and the t pe of fireing, the moulds tend to crack,crumble and deteriorate which will change the shape of the mould drastically,a change generally not appreciated.One will try to create a mould as durable as possible without having to go through the expence of the permanent mould.

One off mould

This mould will have to be broken up to take the piece out which means that the mould-material should be strong enough to do it's task in the firing but soft enough to be easilly broken away afterwards.This mould is used for pieces with undercuts,3D cast pieces,3D fusing,presmoulds in soft material(sand,talc) etc..

II The materials

Listed are :Alumina hydrate,Bentonite,Cement,Ceramic fibre,Grog,Loto,Molocite,Plaster of paris,Sawdust,Silica, Talc,Vermiculite,Whiting,Zircon.

The above mentioned materials are those I have had to deal with in the past few years.I realise that the information about them is still defective but it gives enough information for a basic understanding and startingpoint for further investigation.

Alumina Hydrate($AL_2O_3.3H_2O$)

A fine powder manufactured from beauxite by the Bayer process.It is a major ingredient in kiln-shelf paint(release)In plastermixes it is used as a refractory material.It does not stick to the glass,helps creating a nice surface on the glass

when added to the plastermix.The consistancy of a plastermix with Alumina Hydrate lends it self better to be used for moulds made by pouring than flicking on (see methods).

Bentonite

Aluminum silicate clay,containing some magnesium and iron.Bentonite is used in various adhesives, cements and ceramic fillers.In small quantities added to sand,and maybe other materials as well, it helps firming up the loose matter,when used, without binder,as mould material(see methods)

Cement

Cement consists of various aluminates of silicates of calcium,formed by heating limestone or chalk with clay.

Cement fondue

Cement fondue is a high aluminate cement,a fast drying cement.I have used cement-fondue as binding agent in cementmixes,used for the strong outer shell when making thin moulds.

Ceramic fibre

Ceramic fibre is a material composed af alumina silicate figres.It is on the market as fibre-wool, -paper,-board,and -blanket.It is very lightweight and absorbes less heat during heat up than does insulating firebrick,important factors in kiln-building.Ceramic fibre can be used as mould material or release agent.It doesn't stick to glass but the glass clings to it enough to roughen the sharp edges and smooth surfaces of a fibreboard cutout when used at fusing temperatures.
Ceramic fibre ,soaked in colloidal silica can be used as mould material[4].Ceramic fibrewool or fired ceramicpaper can be used in mouldmixes as refractory material.It tends to lower the chance of the mould cracking.

China Clay (Kaolin) $Al_2O_3.2SiO_2.2H_2O$

China clay is used as a major ingredient in kiln-shelf paint,as binder of aluminum hydrate.It doesn't stick to glass,at least up to temperatures of 960 C.
I have used it as ingredient in the plastermix when using the flicking method because it gives the plaster-mix a nice creamy consistancy,easy to flick, it doesn't run of the piece as easy as other mixes and creates a shiny mat surface on the glass.

Grog

Clay which has been fired and then ground into granules of various particle sizes(not available in powder form).Grog is added toclay bodies to reduce shrinkage after firing.Grog can be added to mixes as refractory material,taking in account that it sticks to glass.
It can be used interchangably with molocite.

Luto

Luto is ground up fired plastermix mould,used as refractory material.It doesn't stick to glass.
It makes cementmixes hang together better and hence more workable and softer after firing.

Molocite

Porcelain,ground up to various grades,available in powderform.Molocite is a refractory material and used as such in plaster and cement mixes.It sticks to glass which,when used as fine powder(200 grit), gives a certain roughness to the glass surface.

Plaster of paris ($CaSO_4.\frac{1}{2}H_2O$)

Gypsum heated to 120 C forms hemi-hydrate gypsum plaster or plaster of paris,which,mixed with water, disolves and cristalises as long needles of $CaSO_4.2H_2O$ which grow together to form a hard solid mass.

Plaster is a binder,a material that undergoes chemical changes.In the firing,at ±600 C such a change happens,whereby water is released and at a much higher temperature an other one which breaks down the structure and the plaster returns to powder.Plaster is a material,wich after it's set as solid mass is verry sensitive to cracking when heated.Because of this sensitivity we work with mixes of plaster and refractory materials and try to find an adequate mix with as little plaster as possible.

Sawdust

Sawdust is organic matter which can be added to the mouldmix.It will burnout at high temperatures and create a more porous mould.

Silica (SiO_2)

Silicondioxide,occurs in nature as five distinct minerales:quarts,tridymite,cristobalite,opal, and lechatelierite.
Silica when used at low temperatures doesn't stick to glass(melts at 1750 C).It is used as refractory material.
Sand is impure silica.

Colloidal silica is fine silica particles suspended in a liquid medium.It is used as a bonding agent in cements. Colloidal silica does stick to glass.

Sodium silicate or waterglass($Na_2SiO_3.9H_2O$) occurs as whith powder soluable in water or a liquid of different viscosities.It is used as a binder in refractory mould mixes and as low temperature flux. It sticks to glass.

Talc ($Mg_6Si_8O_{20}(OH)_4$)

The massive form of talc or hydrous bisilicate of magnesia,is soapstone or stealite.French chalk , potstone and figure stone are all varieties of talc. It is used as a filter for paints,a toilet powder, for insulation and acid resistance,in soap as a lubricant.In mouldmaking it is usefullas releasant and burying material.It leaves a satin finish on the glass.(I assume more applications then the above mentioned).

Vermiculite

Any of a number of hydrous silicates;chiefly resulting from alterations of mica,and occuring in small foliated scales.It is formed from a micaceaus ore, by heating to about 1100 C and consists of a porous, flaky medium of small particles.It is sterile,highly absorbent,retentive of air and water and light in weight.It has a low density,high refractoryness at low temperatures,low thermal conductivity and chemical inertness.

It's used in the building trade,horticulture and in kittylitter.

Because of it's structure(absorbs water inbetween the fillaments and breaks down allong them after firing which helps breaking up the mould after firing) and other quallities it is usefull in mouldmixes.

Whiting

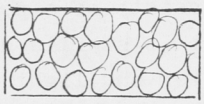
Whiting is chalk prepared by drying and grinding. Chalk is a soft white earthy limestone ($CaCO_2$), consisting chemically of carbonate of lime with some impurities.When burnt it creates lime(CaO) and carbonmonoxide(CO).

Whiting can be used as releasant or burying material. It leaves an almost polished surface on the glass. One disadvantage is the above mentioned chemical reaction wchich creates gass that,when trapped, can blow bubbles in or holes right through the glass.

Zircon($ZrSiO_4$)

Zirconium silicate is used as a refractory material when opaque,as gem when transparant.
In mouldmaking zircon (flour and sand) is used,together with colloidal silica,to create a "ceramic shell".

The above mentioned materials can be devided in two groups :binders and refractory materials. A variety of refractory materials are needed because,besides their specific effect on the glass and other reasons of usage s.a. availability, they are needed to build a sound structure in the mould.
A good assortment in sizes and particle shapes creates a structure that needs less and/or less stable binder.



one filler and one binder,
± 30% binder is needed

mixed fillers and one binder
± 15% binder is needed.

We want to reduce the binder as much as possible because the binder is the one that shrinks,expands and cracks.The binder is the one that is sensitive to temperature and therefor the treatement of the mould after it is made is as important as chosing the materials.

III Drying and fireing

I have delt with moulds using either plaster,cement or colloidal silica as binder.

Plaster moulds

After the mix has set and released the hereby created warmth, physical water needs to evaporate.If time allows leave the mould drying at roomtemperature,in the sun or near a heater.This can take days depending on the thickness of the mould.

One can accelerate this pricess by heating the mould slowly (10° C/hr) to a temperature of ± 50° C in an oven or kiln.Once dry to touch the mould can be heated (10° C/hr) to 110° C in the kiln.Leave the mould at this temperature until the air ,escaping through the air vent,is dry.(Test by holding a piece of glass near the vent,the moist air will condensate on the glass) Then the mould can be heated slowly(50° C/hr) to ± 600° C where a chemical reaction happens in the plaster,creating water which,again,has to evaporate. After holding the mould on 600° C for some time it can be fired to the desired temperature.

Cement-fondue moulds

Most important here is the curing the mould needs after setting.Once the cementmix has set,wrap the piece in soaking wet rags and seal it in plastic.Leave it cure in a cool place for 24 hrs.Unpack and let dry at room temperature.Once touch dry(mould has lighter colour) it can be moved to a warmer drying spot.
From here on I have used the same drying and firing procedure as for the plaster moulds with good results but experimentation towards a faster way can be usefull.

Both plaster and cement like enough time for drying (days to weeks),the more the better. Cracking of the mould can be caused by to little drying time or thermal shock.

Colloidal silica moulds

Colloidal silica,used as binder for ceramic fibre or zircon,needs drying.This can happen at any temperature up to 150° C in a kiln or oven,streight after forming the mould and without sloping up the temperature.Moulds with coll.silica as binder are not prone to thermalshock.
The ceramic fibre mould needs firing at 650° C to obtain it's full rigidity.

Concerning drying and firing scedules of moulds,I'd like to point out that the final firing scedule used will be one that accomodates all participants of the one firing s.a.mould,glass and other s.a.wax.

IV Recipes

Finally,I'd like to give a number of recipes tried and used by various people to give an idea of combinations

1 plaster,1luto,1silica

1 plaster,1molocite,1luto

2 plaster,2 silica,ichina clay,1 luto (I used for method B)

1000 gr plaster,40 gr ceramic fibre,200 gr silica, 200 gr chinaclay,1700 cc water

1 castable (= comercial available cementmix),1 silica,1 plaster

1 plaster,2 molocite,2aluminum hydrate

3 cement fondue,3 castable,5 luto (I used for method B)

6 cement fondue,3 sand/grog,2 vermiculite,1fine clay or fine vermiculite.

Methods of mould fabrication

In the following I will deal with four methods.Which one will use,largly depends on the shape of the piece or mould and the type of mould.

A pouring a plastermix over the positive shape.
B flicking a plastermix at the positive shape
C packing a positive shape in
D pressing the positive shape into a soft material

ad A

When using this method one places the positive shape on a board on the area which faces up on the highest horizontal plane in the firing.A casing is formed around the form and a plastermix poured over it untill totally submerged.[1]
This method is good and quick,the only reason for not using it would be that the shape of the piece would produce a to massive mould or when,for some reason,a thin eaven mould is required.The mould is made of a plastermix and if nescessary, one can reinforce the mould by packing it in with a cementmix(see B and C) or any other way of reinforcement, s.a.wiring, tighing ceramic material/kilnshelf bits around the piece or supporting with firebricks.

ad B

Flicking a plastermix on"the sculptors way" is used when a thin shelllike mould is needed or for reasons method A is not suited. By flicking the mix on it is forced into the fine detail of the piece and the mould will be an exact replica.In case of smooth surfaces a paintbrush or other ways of applying can be used

To build a thin(5-10 mm) mould I've used the following two methods.
1 - Flicking on asrelease and soft buffer between the glass and concrete,a plastermix of ± 5mm.Over this I pack a cementmix of ± 5mm.To make the cement adhere well to the plaster ,the plaster surface is kept rough and a cementmix slury is applied just befor applying the cementmix.The cementmix is applied as soon as possible after the setting of the plaster.
2 - Flick on (same reasons as 1) a releasant slury of refractory material of ± 5mm.Build a thin,2mm,"ceramic shell" over this by coating the piece in a colloidal silica/zircon flour mix and powdering zircon zand onto this.Let dry and repeat ± 4 times.[3]

ad C

I have come across two methods I would classify under packing,being; working with cementmixes and burying or supporting glass with unbound refractory material.

When working with cementmixes,just enough water is added to the mix to make it hang together,the less water the stronger the cement.Bit by bit this mix is padded on or around a form.[5]

One can burry or pack refractory material around a piece of glass when one wants something to happen within the glass structure but keep the outside shape as it was.For example to fuse a joint that sofar hang together with glue or was just pushed together.This job can also be done in method A or B but advantages with this method are that the matter is not applied in liquid state, it is reusable,there is no chance of cracking since no binder is needed,and often only one material is needed. One can use sand ,talc,whiting aluminum hydrate,etc,each leaving a different surface texture.When the material used sticks to the glass a releasant can be pained onto the glass befor burying.

ad D

Using unbound material as in method C,one can mould it with hands,utensils,press shapes in it,build on it with bits ofold mould,fibreboard/paper,etc.Sometimes a little moisture or mix of materials might be needed to give that light firmness.

When using a solid shape as positive,pressed into the material,this mould lends itself well for reproduction of the same shape.

Conclusion

In this paper I have written a little about my source of inspiration and about a particular technical area. The actual areas delt with might be limited and incomplete but what the paper does give is an outlook upon my way of operating.There is one side in me that lives very intensly, observes,experiences and reacts and an other that is very rational,logical and questioning.It's from these two sides that I have approached the medium.

At this point I like to thank those who have helped me getting trained up and ready for the start.Now it's up to me to ride my horse through many finishes.Though,in between them,I will still be looking for the old and new coaches and fellow riders ,to learn more about the race,it's ethics, style and tactics.

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Reference to the numbers

1 - see Glass Fusing p.92/93
2 - see Glass Fusing p.89
3 - see Sculpture Casting p.141
4 - see Glass Fusing p.87/88
5 - see Glass Fusing p.89
6 - see The technique of casting for sculpture p.50

The above mentioned books are all available at the C.S.A. library.